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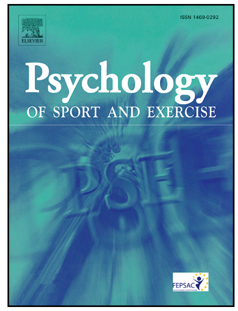

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Abstract

Tse, Wong, and Masters (2017) recently published a study that indicated that analogy instruction may help older adults acquire resilient motor skills that require reduced cognitive processing compared to traditional explicit instruction. Although we do not dispute that analogy learning may prove useful for this population, in this commentary, we contend that there are methodological issues in this research—which are shared with previous studies comparing analogy and explicit instruction—that potentially limit ecological validity, impact the size of detected effects, influence the development and understanding of associated theory, and, as such, constrain resulting recommendations for applied practice. Of particular concern is the comparison of the *single*-item analogy instruction to the list of *nine* explicit instructions, which risks conflating the effects of the *type* of instruction with the *volume* of instruction. We further argue that the benefits of analogy may be more parsimoniously explained by the instruction's capability to succinctly convey skill (rather than its potential for limiting reinvestment), but that this capability may only be realised if the to-be-learned analogy is relevant and readily understood by the learner. Finally, we suggest that research in this area must look to incorporate more rigorous methods that compare experimental conditions to representative reference groups that allow us to explore how and when to deploy the myriad instructional tools available to practitioners and learners.

Keywords: motor learning, instruction, explicit instruction, analogy, coaching

In a recent study, Tse, Wong, and Masters (2017) investigated the efficacy of analogy instruction in motor learning for older adults. The authors suggested that older adults may benefit from analogy instructions, as the analogy learners demonstrated more robust performance under pressure and reported fewer verbal rules than their explicit-learning counterparts. These findings clearly correspond with previous research with young adults (e.g., Lam, Maxwell, & Masters, 2009a, 2009b; Liao & Masters, 2001) and, more recently, with adolescents (Tse, Fong, Wong, & Masters, 2017). We are concerned, however, that limitations in the study by Tse, Wong, et al. (2017), which notably reflect consistent and prevalent issues in the associated literature, continue to skew the debate concerning analogies and explicit instructions, making it more difficult for applied practitioners to equitably evaluate the available instructional tools. This commentary sets forth these issues and presents suggestions for future research in this area.

1. Quantity and quality of instructions may confound the control condition and misrepresent practice

As shown in table 1, explicit instructions have traditionally outnumbered analogy instructions throughout the literature by margins that misrepresent real-world settings (Bobrownicki, MacPherson, Coleman, Collins, & Sproule, 2015). In their recent study, Tse, Wong, et al. (2017) have continued to follow this customary, but arguably unrepresentative, research paradigm by comparing a *single* analogy to *nine* explicit instructions. According to Lam et al. (2009b), in studies such as this, a “fairer comparison might be achieved” (p. 189) by matching the number of rules for these instruction types. Indeed, Bobrownicki et al. (2015) stressed that research in analogy and explicit instruction should aim to avoid these disparate instructional protocols, because these informational imbalances create questionable reference groups, present issues with working memory capacity, and conflict with recommended coaching practice (e.g., Mannie, 1998; McQuade, 2003; Schmidt & Wrisberg, 2004; UK Athletics, 2009), serving to limit the relevance and generalisability of any findings. Unfortunately, only a few studies to this point have looked to implement such controls on instructional quantity (Bobrownicki et al., 2015; Schücker, Ebbing, & Hagemann, 2010; Tse, Fong, et al., 2017). Although Tse, Wong, et al. (2017) acknowledged this issue concerning the number of instructions toward the end of the discussion section, the instructional imbalance required greater attention given the previous criticisms, the limited ecological validity, and the implications for applied practice. As many of the same authors (Tse, Fong, et al., 2017) have previously acknowledged that real-world instruction is ordinarily provided in a step-by-step manner (i.e., one or two instructions at a time) rather than many instructions all at once, it is not necessarily clear why this apparent imbalance continues to persist in the analogy and explicit instruction literature.

In addition to issues of *quantity*, however, there are also concerns regarding the *quality* of the explicit instructions in the study of Tse, Wong, et al. (2017), as explicit learners were provided specific movement information that possessed limited correspondence to the analogy instruction and the aims of the task. For example, the explicit rules to position feet 'side on at 45° to the table' and to rotate 'hips, waist, and shoulders forward when *serving'* provided excess information that was neither conveyed in the single analogy instruction to 'move the racket such that it is travelling up the side of a mountain' nor pertinent to the top-spin forehand *return* task, which did not include any service (balls were delivered to participants in the return task by machine). As research has indicated that analogies may be differentially effective and interact with characteristics of the learner, such as culture (Poolton, Masters, & Maxwell, 2003) or skill level (Schlapkohl, Hohmann, & Raab, 2012), quality and relevance of these instruction types deserve much needed attention from researchers and practitioners alike.

**** Table 1 near here ****

2. Selection of control conditions may overstate or mask effects

According to Goginsky and Collins (1996), the selection and design of the control or reference groups represent critical considerations for sport psychology researchers, as it has been empirically demonstrated that unrealistic control groups can influence effect sizes and confound results compared to more representative controls (e.g., Winter & Collins, 2013). With this in mind, the long lists of explicit instructions found in the study of Tse, Wong, et al. (2017)—and many of those studies in Table 1—may not only limit ecological validity, but the resulting, imbalanced experimental comparisons may also empirically overstate the benefits of analogy learning.

For instance, this issue was highlighted in the study of Bobrownicki et al. (2015) where the effect sizes, when compared to the analogy condition in a jumping task, were $d = 1.44$ for the "traditional explicit" condition (eight unique explicit rules to reflect traditional explicit conditions), but $d = .83$ for the "explicit light" condition (number of words reduced to match to analogy instructions). Although the analogy learners still demonstrated the most efficient jumping technique on average compared to the explicit light and traditional explicit conditions, respectively, these differences were not statistically significant and, crucially, the reduction in instructional volume appeared to mitigate the deleterious effects typically associated with explicit instruction. These results suggest that the research of Tse, Wong, et al. (2017)—and many of those from Table 1—could be overestimating analogy's benefits by conflating the effects of the *type* of instruction with the *volume* of instruction through unrepresentative reference groups. Of course, this interpretation does not preclude that analogies are offering genuine—if perhaps smaller than originally stated—advantages to learners over explicit methods (e.g., integration of movement subcomponents, Gestalt processing, differential working memory consumption), but that these findings are being confounded or masked by pervasive instructional inequalities.

Unfortunately, instructional quality and quantity have received limited attention from researchers to corroborate these hypotheses or further explore these concepts. Tieleman (2008) conducted pilot studies examining the quality and quantity of rule-based instruction, which would later be used to inform the work of Schlapkohl, Hohmann, and Raab (2012), but the original data remain unpublished. Tse, Fong, et al. (2017) and Schücker et al. (2010) also matched the number of instructions for the analogy and explicit instruction groups, but both analogy and explicit conditions in these studies were provided with quantities of instructions (11 rules and 30 rules, respectively) that may have exceeded participants' working memory capacities, as suggested by Ille and Cadopi (1999). The issues of working memory capacity notwithstanding, these investigations produced mixed results with Tse, Fong, et al. (2017) observing that adolescent analogy learners performed more robustly under a secondary task load, while Schücker et al. (2010) did not find a benefit for analogy learning under pressure conditions compared to traditional explicit methods. It is conceivable that these aforementioned issues with instructional quality, quantity, and selection of reference groups have contributed to the "somewhat inconsistent" (p. 15) results for analogy instruction, as identified by Gröpel and Mesagno (2017) in a recent review of choking interventions.

3. The value of analogy may lie in its concision

Analogy has been presented as a means of forestalling skill failure under pressure (Lam et al., 2009a); however, the premise that analogy instruction engenders less verbal knowledge and, in turn, limits potential for reinvestment is largely predicated, to date, on research that succumbs to issues highlighted under the first two subheadings. Indeed, it should not be surprising to Tse, Wong, et al. (2017) that participants asked to memorise nine instructions (Table 1) might perform less robustly under pressure and report more verbal rules at the conclusion of the study than in a single-instruction analogy condition. As Bobrownicki et al. (2015) argued, analogy's greatest strength, at least from an applied perspective, may instead rest on its potential to parsimoniously deliver relevant instructions, succinctly compiling information regarding movement subcomponents into an easy-to-deliver package. Harking back to earlier, more cognitive considerations of effective coaching, analogies can provide opportunities to make connections to previously embedded concepts that might otherwise be delivered in several explicit chunks. They are also noticeably simpler, helping to conserve important capacity in short-term working memory (cf. Cowan, 2001).

4. Establishing relevance and understanding

The potential for an analogy to deliver on its abbreviated form can only be realised, however, if the to-be-instructed analogy is relevant and readily understood by learners. In this regard, previous findings have suggested that a range of factors, such as cultural and individual differences, can affect analogy effectiveness (Poolton, Masters, & Maxwell, 2007). For example, the same table tennis analogy (pretend to draw a right-angled triangle with the bat) that was previously successful with English speakers (Liao & Masters, 2001) proved ineffective for Chinese-speaking participants (Poolton et al., 2003). Of course, such issues should also affect explicit instructions too, as the use and understanding of language is thought to vary from person to person (Reed, 1996). Despite this, however, Tse, Wong, et al. (2017), like most studies before (see Table 1), have not incorporated any checks to probe participant understanding of either type of verbal instruction. We would posit that participant understanding may represent an even more critical consideration than loyalty to any specific type of instruction which warrants careful emphasis from researchers and practitioners alike as they develop research and practice in the future.

5. Future directions

While Bobrownicki et al. (2015) did aim to control instruction quantity, the next steps might involve systematically controlling both the quantity and quality of the analogy and explicit instructions. This would enable the exploration of effective *and* ineffective analogy and explicit instructions (e.g., complexity; valence; familiarity; learning versus performance; short-term versus long-term effects; and interactions with the needs, preferences, and characteristics of learners and performers). At present, there exists limited scientifically informed guidance for either the development of effective verbal instructions or the pre-emption of potential issues, so this proposed line of enquiry represents necessary research for informing applied practice, especially as earlier investigations have indicated that analogies may not be universally effective (e.g., English- versus Chinese-speaking participants; Poolton, Masters, & Maxwell, 2003). Given the inconsistent findings to date (Gröpel & Mesagno, 2017), the relatively small sample sizes common throughout the literature will require attention, as adequately powered studies represent prerequisites for systematic replications and for controlling rates of error (Schweizer & Furley, 2016). It may be that the above recommendations constitute a research programme that is achievable through Mellers, Hertwig, and Kahneman's (2001) guidelines for adversarial collaboration, which call for joint research under mutually agreed protocols to address opposing interpretations or experimental refutations (we should stress that *adversarial* is the adjective chosen by Mellers et al. and not one that we would otherwise use to describe Tse, Wong, et al.).

While quality and quantity may represent primary concerns at present, we do not rule out that the effects of these verbal instruction types are moderated only by these. For instance, given the literature's predicted, distinct pathways for implicit and explicit approaches (e.g., Zhu, Poolton, & Masters, 2012), it may or may not be that analogy and explicit instructions differentially activate specific areas or processes of the brain. From our perspective, however, it is first necessary to address the concerns regarding quantity and quality before these other possible moderators, such as cortical activation or multimodal learning, can be appropriately investigated.

6. Concluding thoughts

Through the course of this commentary, we have raised issues regarding the study of Tse, Wong, et al. (2017), many of which also pervade the literature as cited in Table 1. In doing this, we are not disputing that analogies represent a potentially useful tool for practitioners; indeed, the rationale is sound and makes intuitive sense, especially if mechanistic explanations consider wider and perhaps more parsimonious explanations than a sole reliance on reinvestment. Rather, we are concerned that methodological shortcomings may be misrepresenting or overstating their usefulness, while also holding back research and practice. For us, given the complexity of real-world sporting environments, analogy represents *one* of a number of useful tools (e.g., constraints, external focus of attention, demonstration, understanding) that practitioners may dynamically adopt to suit the athlete, the sport, the learning/performance environment, and the desired outcomes (e.g., short-term adjustment versus long-term development). *None* of these available instructional tools is universally effective, however, and application cannot occur directly from theory without consideration of both their strengths and limitations (Abraham & Collins, 2011). Going forward, rather than rely on mismatched and artificial comparison groups to promote the efficacy of analogies, research should aim to compare them to representative reference groups, while also systematically investigating how, when, and why they might work.

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Table 1. *Comparison of studies in sport and exercise investigating differences between analogy and explicit instructions*

Study	Task	Pressure manipulation	Measures	Conditions	Number of rules	Number of words
Tse, Wong, and Masters (2017)	Table tennis topspin forehand	Backwards counting	Target accuracy	Young analogy (*n* = 18)	1	14
				Old analogy (*n* = 17)	9	78
				Young explicit (*n* = 18)	1	14
				Old explicit (*n* = 17)	9	78
Tse, Fong, Wong, and Masters (2017)	Rope skipping for adolescents	Backwards counting	Successful skips	Analogy (*n* = 15)	11	104 *
			Technique (rated)	Explicit (*n* = 17)	11	113 *
Bobrownicki, MacPherson, Coleman, Collins, and Sproule (2015)	High jumping	Rising high-jump bar	Highest height cleared	Analogy (*n* = 7)	2	20
			Technical efficiency	Explicit light (*n* = 7)	3	20
			Joint angle variability	Traditional explicit (*n* = 7)	8	96
Schücker, Hagemann, and Strauss (2013)	Golf putting	Tone judgement	Putt accuracy	Analogy (*n* = 20)	1	6 †§
		Prize money		Explicit (*n* = 21)	6	86 §
		Peer comparison				
Schlapkohl, Hohmann, and Raab (2012)	Study 1: Table tennis forehand	Decision making	Target accuracy	Analogy (*n* = 24)	1	11
			Movement pattern	Explicit (*n* = 22)	5	88
				Control (*n* = 10)	0	0
	Study 2: Table tennis forehand	Decision making	Target accuracy	Analogy (*n* = 20)	1	11
			Movement pattern	Explicit (*n* = 20)	5	88
				Control (*n* = 10)	0	0
	Study 3: Table tennis					
	Undercut stroke	Decision making	Target accuracy	Discus analogy (*n* = 8)	1	10
			Movement pattern	Explicit (*n* = 7)	5	83
	Counter hit	Decision making	Target accuracy	Soldier analogy (*n* = 8)	1	14
			Movement pattern	Explicit (*n* = 7)	5	88
	Topspin forehand	Decision making	Target accuracy	Stroke analogy (*n* = 8)	1	16
			Movement pattern	Explicit (*n* = 7)	5	82
Koedijker, Poolton, Maxwell, Oudejans, Beek, and Masters (2011)	Table tennis topspin forehand	n/a	Target accuracy	Analogy (*n* = 14)	1	14
				Explicit (*n* = 15)	5	46
Schücker, Ebbing, and Hagemann (2010)	Golf swing	Tone judgement	Drive distance	Analogy (*n* = 28)	30	n/a

			Drive deviation from centre	Explicit (n = 23)	30	n/a	
Hu and Xu (2009)	Table tennis topspin forehand	n/a	Target accuracy scores	Analogy (n = 11)	1	n/a	#
				Explicit (n = 11)	8	n/a	#
Lam, Maxwell, and Masters (2009a)	Seated basketball shooting	Expert evaluation	Shooting performance	Analogy (n = 12)	1	17	
			Probe reaction times	Explicit (n = 12)	8	81	
Lam, Maxwell, and Masters (2009b)	Seated basketball shooting	Backwards counting	Shooting performance (rated)	Analogy (n = 9)	1	19	
			Arm kinematics	Explicit (n = 9)	8	78	
				Control (n = 9)	0	0	
Koedijker, Oudejans, and Beek (2007)	Table tennis topspin forehand	Prize money	Target accuracy	Analogy	2	≈ 33	‡
		Backwards counting	Movement quality (rated)	Explicit	14	88	‡
				Environmental focus	2	n/a	
				Movement focus	1	≈ 4	‡
Poolton, Masters, and Maxwell (2007)	Table tennis topspin forehand	Backwards counting	Target accuracy	Analogy (n = 14)	1	n/a	#
				Explicit (n = 14)	6	n/a	#
Poolton, Masters, and Maxwell (2006)	Table tennis topspin forehand	Decision making	Target accuracy	Analogy (n = 15)	1	14	
				Explicit (n = 18)	6	53	
Law, Masters, Bray, Eves, and Bardswell (2003)	Table tennis topspin forehand	Audience observation	Target accuracy	Analogy (n = 14)	1		
				Explicit (n = 14)	6		
Liao and Masters (2001)	Table tennis topspin forehand	Backwards counting	Target accuracy	Analogy (n = 10)	2	≈ 29	‡†
				Explicit (n = 10)	12	n/a	‡†
				Implicit (n = 10)	0	0	†

* Study protocols integrated with skill instructions † Participants also provided additional visual demonstrations or verbal instructions

§ Participants also received pictures demonstrating technique # Instruction provided in Chinese ‡ Exact wordings of instructional groups not provided